ABSTRACT

According to the World Health Organization (WHO), primary cause of death worldwide is cardiovascular diseases (CVDs). By 2030, it is predicted that 23.6 million people will have died from CVDs, which account for 30% of all deaths worldwide. CVDs involves sudden cardiac death (SCD), is a condition brought caused by arrhythmia, Arrhythmias includes heart blocks, atrial fibrillation, supra ventricular tachycardia, ventricular atrial fibrillation and ischemia depending on the underlying cause of the condition affecting the heart. On the other hand, poor cardiac consultations in India has shortage of specialist in rural areas, which affects the clinical diagnosis particularly in "Golden Hour.". However, the Indian government is working hard to build hospitals in rural areas. Telecardiology could be a solution to this serious issue. Telecardiology powered by the Internet of Things (IoT) provides better medical care, cardiovascular disease (CVD) management. IoT-based telecardiology uses tele-ECG, tele-consultations, tele-echocardiography and e-teaching. A specialist may make diagnosis and organize care for people in rural areas while working from a metropolis. ECGs data can be analyzed and patient information can be shared in real time. The IoT offers a framework for connecting medical equipment to collect, analyze, transmit, link to specialists, or store data in the cloud or servers.

Arrhythmia can be investigated using non-invasive electrocardiogram (ECG). ECG comprises of P waves, T waves, and the QRS complex. The ST segment anomalies are brought on by the flow of destruction currents, which are caused by the electrical discrepancies between the ischemic and non-ischemic myocardial during the plateau and resting intervals of the ventricular action potentials. ECG signal processing is becoming a common and practical tool for scientific study and medical care. Pre-processing the ECG data, identifying ECG characteristic spots, and feature extraction are the typical phases of a computer-based ECG analysis system followed by classification of arrhythmia beats. We have developed novel algorithm for this critical issue in this research work. Firstly, the ECG signal is pre-processed, the baseline wander noise is eliminated using a Savitzky-Golay filter and high frequency noise is removed using a MOWPT (maximum overlap discrete wavelet packet transform) for MIT-BIH records. In terms of SNR and MSE, the proposed method

performs better than the existing methods. Then delineation process has been performed using discrete wavelet transform, the proposed approach outcome shows average sensitivity as 99%, and positive predictivity is 100%. After detection process, the features are given to as input to deep learned CNN for classification. The classification results show Accuracy as 99.12%, Sensitivity as 100 % and Specificity as 99.9%. After classification of arrythmia, the data is transmitted to the specialist through secured network, which employs an encryption authentication mechanism. The information is then encrypted using the triple data encryption standard (3-DES) algorithm in cipher-block-chaining (CBC) mode. This method transmits encrypted data and a verification tag that allows the receiver to confirm the data's authenticity. As a result, a new algorithm is proposed for generation of initialization vector key i.e., water cycle optimization (WCO) algorithm. As compared to existing encryption authentication algorithm, we have achieved better results i.e., the value of Avalanche Effect is 50.12%, MSE is 0.4639, execution time is 0.003sec, NCPR is 100 and UACI is 39.698. The encryption and authentication data are transmitted to doctor via Telecardiology using Thing speak (IoT) platform for real time monitoring. We developed a logged platform in this IoT with a user ID and password and uploaded the data, after which it was sent to the cardiologist for further investigation.

In addition to this, we have also developed new algorithm for detection of ischemia for 10 selective records of European ST-T database. ST deviation in ECG records has been identified and named it as Modified Isoelectric Energy Function. After usage of this proposed algorithm, we got the average sensitivity (SE) is 98.5%, while the average specificity (SP) is 98.3%. These results outperform those of other methods that have been cited in the literature.